MOTOR APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a motor apparatus for reducing the vibration of a motor, and particularly to a motor apparatus suitable for an image reading apparatus or the like.

Related Background Art

Ins a'

~~In an image reading apparatus used in a copying~~ machine or the like, a stepping motor has heretofore been used because highly accurate positioning of a movable member is required. To drive the movable member of the image reading apparatus at a high speed with low vibration by the stepping motor, the through-up and through-down of the motor are requisite. ?

Also, to read color information, reading at a constant speed free of vibration is necessary and therefore, it is popular in the design of the apparatus to provide an approach run distance required until the vibration created after through-up becomes null. ?

Also, regarding the ~~vibration in the~~ constant speed portion of the motor rotation, the motor becomes a vibration source due to a torque ripple conforming to a step angle and the thin lines of an image become jaggy. Against this problem, it is possible to use a ~~magnet damper which does not give an inertia to a motor~~

Ins a1 amd'd

~~shaft during the aforementioned through-up, but gives~~ an inertia to the motor shaft during a constant speed for the reason set forth later to thereby smooth the rotation between step angles, and it is possible to ~~reduce the vibration.~~

It is also possible to fractionate the step angle of the motor to thereby reduce the torque ripple and reduce the vibration.

Ins. a2

~~However, the reading number of the image reading~~ apparatus per unit time has become higher in speed year by year and therefore, it has become impossible to secure a sufficient approach run distance. Also, when the inertia working during acceleration is attached to the motor shaft, the through-up time increases and a higher speed has become impossible and a very great inertia could not be given. Therefore, the vibration components of the distal end of a read image have become many and the said distal end has become jaggy, and this has caused a great reduction in the dignity of image.

The reason set forth above has become a factor for greatly reducing the dignity of image by being jaggy or a factor for hindering the downsizing of the apparatus by the increase in the approach run distance resulting ~~from a higher reading speed.~~

SUMMARY OF THE INVENTION

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~~The present invention has been made in view of the above-noted situation and an object thereof is to provide a motor apparatus reduced in vibration caused during acceleration and during a constant speed.~~

Another object of the present invention is to mount two damper means on a motor drive shaft to thereby reduce vibration caused during the driving of the motor.

Still another object of the present invention is to use a magnet damper as a first damper means and use a rubber damper as a second damper means.

Ins. a4

~~Yet still another object of the present invention to use a magnet damper and a rubber damper to shorten the reading time of an image reading time to thereby heighten the speed of the apparatus.~~

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the image processing circuit of a digital full color copying machine according to the present invention.

Fig. 2 shows the construction of an image reading apparatus including the image processing circuit of Fig. 1.

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~~Fig. 3 is a simple view of a moving mechanism provided with only a magnet damper.~~

~~Fig. 4 shows the relation between the state of the vibration of a first mirror of an image reading~~

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~~apparatus and the speed of a motor shown in Fig. 3.~~

Fig. 5 is a simple equivalent view of the motor using only the magnet damper shown in Fig. 3.

Fig. 6 is a simple view of a moving mechanism according to an embodiment of the present invention using two damper means, i.e., a magnet damper and a rubber damper.

Fig. 7 is a simple equivalent view of a motor using only a rubber damper.

Fig. 8 shows the relation between the state of the vibration of the first mirror of the image reading apparatus and the speed of the motor shown in Fig. 7.

Fig. 9 shows the construction of the moving mechanism of the image reading apparatus shown in Fig. 2.

Fig. 10 is a view of the rubber damper shown in Fig. 7.

Fig. 11 is a view of the magnet damper shown in Fig. 3.

Ins. a6

~~Fig. 12 is a simple equivalent view of a motor using the magnet damper and the rubber damper shown in Fig. 6.~~

DESCRIPTION OF THE PREFERRED EMBODIMENTS

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~~Fig. 1 is a block diagram of the image processing circuit of the digital full color copying machine of the present invention. The reference numeral 100~~

Ins a7 end

~~designates the main substrate of the image processing circuit which includes the following parts.~~

The reference numeral 101 denotes a three-line CCD for color-resolving the reflected light from an original and converting it into an electrical signal. The reference numeral 102 designates an A/D converting portion for converting an analog signal RGB from the CCD 101 into a digital signal.

A shading correction portion 103 corrects the sensitivity of each pixel of the CCD 101 and corrects the inclination of the quantity of light of a light source. In Fig. 1, R (red), G (green) and B (blue) signals are 8-bit digital image signals outputted from the A/D converting portion 102.

Ins. a8

~~The CCD 101 used in the present embodiment comprises three CCD line sensors for R (red), G (green) and B (blue) disposed at predetermined distances. Therefore, the digital image signals are signals having time deviation created by spatial deviation. This time deviation is corrected in a three lines connecting portion 104 in Fig. 1.~~

An input masking portion 105 effects a calculation for correcting the RGB spectral characteristic of the CCD 101 to a standard RGB space.

A LOG converting portion 106 is a look-up table comprised of a RAM, by which R (red), G (green) and B (blue) luminance signals are converted into C (cyan), M

(magenta) and Y (yellow) density signals, respectively.

A masking/UCR portion 107 effects a calculation for removing the color turbidity of toners used for print recording from the inputted C (cyan), M (magenta) and Y (yellow) density signals and produces a Bk (black) signal.

Ins a9

~~A F value correction portion is a correction table,~~ for correcting a density value (F value) for each color in accordance with the designation of the density at which printing is to be effected.

The reference numeral 108 designates a tristate buffer which is controlled by an ADD-IN signal. The reference numeral 110 denotes an image processing substrate provided with a tristate buffer 111 and an image processing portion 112. The image processing portion 112 is a portion for effecting such processing as extracting the outline portion of an image. The reversed signal of the ADD-IN signal is inputted to the tristate buffer 111. Therefore, the tristate buffer 111 and the tristate buffer 108 are in a converse relation so that if one of them becomes high impedance, the other may become low impedance. Accordingly, when the ADD-IN signal is "1", the tristate buffer 108 becomes high impedance and an image signal flows through the masking/UCR portion 107, the image processing portion 112, the tristate buffer 111 and the ~~F value correction portion 109 in the named order.~~

Ins. a9 concld.

When conversely, the ADD-IN signal is "0", the tristate buffer 111 becomes high impedance and an image signal flows through the masking/UCR portion 107, the tristate buffer 108 and the F value correction portion 109 in the named order.

Fig. 2 is a block diagram schematically showing the construction of a color image reading apparatus according to the present embodiment.

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This apparatus is provided with original-supporting glass 202 for supporting an original 201 thereon on the upper portion thereof, and an original supporting table cover 203 for keeping the supported original 201, and below these, there is provided an optical system comprised of an original illuminating lamp 209, a first mirror stand 204, a second mirror stand 205, an imaging lens 206, a color CCD (fixed image element) line sensor (corresponding to 101 in Fig. 1, and hereinafter referred to as the line sensor) 207 having a filter (not shown) for resolving three colors, i.e., R (red), G (green) and B (blue), and an image processing circuit 208.

A mirror 210 is fixed to the first mirror stand 204, and mirrors 211 and 212 are fixed to the second mirror stand 205. A CPU 213 is connected to the image processing circuit 208, the operation of which is controlled by the CPU 213. Also, design is made such that the original illuminating lamp 209 has its

Ins. a10 cancel'd

~~operation controlled by the CPU 213 through a driving circuit, not shown, and the first and second mirror stands 204 and 205 have their operations controlled by the CPU 213 through a driving mechanism, not shown.~~

Also, the first mirror stand 204 and the original illuminating lamp 209 scan the original 201 placed on the original supporting glass 202 at a speed double that of the second mirror stand 205.

Ins. a11

~~The original 201 placed on the original supporting glass 202 is illuminated by the original illuminating lamp 209. The reflected light from the original is directed by the mirrors 210, 211 and 212, and is imaged on the line sensor 207 through the imaging lens 206. The reflected light is resolved into R component, G component and B component as color image information by the color resolving filter of the line sensor 207, and thereafter is sent to the image processing circuit 208. By the electrical scanning (main scanning) by the line sensor 207 and the mechanical scanning (sub-scanning) by the original illuminating lamp 209 and the mirrors 210 to 212 being repeated, the image information of the whole area of the original is read.~~

In the image processing circuit 208, the inputted image information is subjected to predetermined image processing, and is outputted as an image signal to a printer or the like connected to the outside.

Ins. a12

~~Fig. 9 is a perspective view showing a moving~~

Ins a12 cont.

~~mechanism for the image reading apparatus to be moved.~~ This construction is an already known construction used in a popular flat bed type image reading apparatus. In order to scan the original, the original illuminating lamp 209 which is an illuminating source and the first mirror 210 are moved at a predetermined speed as indicated, for example, by the direction of arrow, and the second and third mirrors 211 and 212 are moved at a half speed of the predetermined speed.

For this purpose, rotation is transmitted from a motor 40 to a rotary shaft 44 through a belt 42, and the rotation of the rotary shaft 44 is further transmitted to a belt 48 passed over a pulley 46, and the original illuminating lamp 209 which is the illuminating source and the first mirror 210 are carried on the first mirror stand 204 attached to the belt 48, and the second and third mirrors 211 and 212 are carried on the second mirror stand 205.

Assuming now that the original image is read when the first mirror stand 204 and the second mirror stand 205 are moved in the direction indicated by arrow, to obtain an image of high dignity which is little jaggy, it is desirable that the vibration of the first mirror stand and the second mirror stand is little to the utmost.

So, in the present invention, a magnet damper has ~~been chosen from among a plurality of kinds of dampers.~~

Ins a12 cancel.

~~which can be mounted on the motor shaft, and this magnet damper has been examined. In the construction of a moving mechanism having this magnet damper mounted thereon, vibration has occurred when the first mirror 210 is through-up to a predetermined speed.~~

Fig. 3 shows a simple view of a moving mechanism having only a magnet damper attached thereto. Here, for the simplification of description, only the first mirror stand is driven, but the same thing can also be said even if the second mirror stand is attached.

In Fig. 3, the reference numeral 301 designates a stepping motor (corresponding to the motor indicated by the reference numeral 40 in Fig. 9) as an example of the drive source of the moving mechanism. The reference numerals 302 and 303 (the reference numerals 46 and 46 in Fig. 9) denote wire pulleys, and the reference numeral 307 designates a minimum necessary force F for moving a first mirror stand 306. The weight of the first mirror stand 306 (the reference numeral 204 in Fig. 9) is W. The reference numeral 309 denotes a rail for the first mirror stand to be parallel-moved. The first mirror stand is moved with a coefficient of friction μ with respect to the rail.

Here, $F = Fa + \mu W$ (μ: the coefficient of friction).

Ins: a13

~~In Fig. 3, the reference numeral 310 designates a magnet damper which is of a construction having inertia~~

Ins a13 cont.

~~connected to the motor shaft by a magnet, and is of~~ such a construction which does not react to the accelerating operation such as the acceleration or deceleration of the motor shaft, but has an inertia when the motor shaft is at a constant speed.

Fig. 11 shows the configuration of the magnet damper. The reference numeral 1101 designates the inertia member of the magnet. The reference numeral 1103 denotes a hub made of iron. The reference numeral 1102 designates a rulon made of a material of a low coefficient of friction such as Teflon. During the acceleration of the motor, the hub 1103 and the inertia member 1101 of the magnet slidingly move because the rulon 1102 is mounted on the motor shaft and therefore, the inertia of the magnet damper applied to the motor shaft is weak. On the other hand, when the motor shaft is rotated at a constant speed, the hub 1103 and the inertia member 1101 of the magnet are rotated therewith and therefore, the inertia of the magnet damper applied to the motor shaft is applied.

Fig. 5 shows a simple equivalent view of a motor using only a magnet damper. In Fig. 5, the reference numerals 501 and 502 designate springs, and the reference numeral 503 (corresponding to the reference numeral 301 in Fig. 3) denotes a motor which provides a vibration source together with the springs 501 and 502. ~~The reference numeral 504 indicates that the inertia~~

Ins a! cont.

~~member 505 (corresponding to the reference numeral 1101~~ in Fig. 11) of the magnet and the motor 503 which is a vibration source are connected together. Since it is connected by the magnet, the inertia member 505 does not react during acceleration, and design is made such that when the motor is at a constant speed, the inertia member 505 is applied to the motor 503 which is a vibration source.

It is Fig. 4 that shows the relation between the state of the vibration of the first mirror stand 306 when the motor is through-up and the speed of the motor. In Fig. 4, the reference numeral 401 designates a waveform showing the state of the attenuation of vibration caused during the through-up of the motor, and the axis of Y-direction indicates acceleration G, and X-direction indicates time t. The reference numeral 402 denotes the through-up waveform of the motor, and Y-direction represents speed and X-direction represents time t. In the waveform 402, the reference numeral 404 designates an acceleration area, the reference numeral 405 denotes an approach run area for eliminating the vibration produced during the through-up, and the reference numeral 406 designates an image reading area for reading an image when the vibration during the through-up becomes null. In a moving mechanism having only a magnet damper mounted thereon, ~~a time t1 was necessary from after the starting of the~~

Ins. a13 concl'd.

~~motor until the vibration during the through-up was~~ attenuated and image reading became possible.

Here, the present invention has thought out to mount one more damper on the motor shaft having a magnet damper mounted thereon, and has chosen as said one more damper a rubber damper from among a plurality ~~of kinds of dampers mountable on the motor shaft.~~

Fig. 6 shows a simple view of a moving mechanism having the two dampers of the present invention, i.e., the magnet damper and the rubber damper, mounted thereon. Here, to simplify the description, only a first mirror stand is driven, but the same thing can be said even if a second mirror is mounted.

In Fig. 6, the reference numeral 601 denotes a stepping motor as an example of the drive source of the moving mechanism. The reference numerals 602 and 603 designate wire pulleys, and the reference numeral 607 denotes a minimum necessary force for moving a first mirror stand 606. The reference numeral 605 designates an extraneous force Fa. The weight of the first mirror stand 606 is W. The reference numeral 609 denotes a rail for the first mirror stand to parallel-move thereon. That is, what are designated by the reference numerals 601 to 609 in Fig. 6 correspond to what are designated by the reference numerals 301 to 309 in Fig. 3. The first mirror stand is moved with a coefficient μ of friction with respect to the rail.

Here, $F = Fa + \mu W$. (μ: a coefficient of friction)

Ins a14

~~In Fig. 6, the reference numeral 610 designates a~~ magnet damper designed to have inertia connected to the motor shaft by a magnet, and it is of such a construction that does not react during the accelerating operation of the motor such as acceleration and deceleration, but has inertia when the motor shaft is at a constant speed. The reference numeral 611 denotes a rubber damper mounted on the motor shaft to reduce the vibration caused during the through-up.

The reason why the rubber damper has been chosen as one more damper will now be described in detail.

Fig. 7 shows a simple equivalent view of a motor using only a rubber damper. In Fig. 7, the reference numerals 701 and 702 designate springs, and the reference numeral 703 (corresponding to the reference numeral 301 in Fig. 3) denotes a motor which provides a vibration source together with the springs 701 and 702. The reference numeral 704 designates a spring, the reference numeral 705 denotes a dash pot, and the reference numeral 706 designates inertia which is the equivalent constituent of a rubber damper 707.

Fig. 10 shows the configuration of the rubber damper. The reference numeral 1001 denotes inertia made of iron or the like. The reference numeral 1003 ~~designates a hub which is connected to the motor shaft.~~

Ins. a14 encl'd.

~~The reference numeral 1002 denotes a rubber material~~, and by the quality thereof, the characteristics of the spring 704 and the dash pot 705 are changed. Consequently, it becomes possible to load a spring-mass system by the rubber damper in conformity with the natural frequency of a load produced during the through-up and suppress vibration by the utilization of resonance (hereinafter referred to as the dynamic ~~vibration absorption)~~.

The central frequency of this dynamic vibration absorption is indicated as follows:

$$f = (1/2\ \pi) \times \{980 \times (K/J)\}^{-2},$$

where f: dynamic vibration absorption frequency, k: spring constant (g•cm/rad), J: moment of inertia (g•cm).

Ins. a15

~~Consequently, the vibration during the through-up~~ is reduced by varying the rubber material 1002 regarding the spring constant and the inertia 1001 and using them in accordance with the natural vibration frequency of the load during the through-up of an image reading system.

It is Fig. 8 that shows the relation between the state of the vibration of the first mirror stand 606 when the motor is through-up by the construction of the moving mechanism using this rubber damper and the speed of the motor. In Fig. 8, the reference numeral 801 ~~shows the state of the attenuation of the vibration.~~

Ins. a15 cont.

~~caused during the through-up of the motor, and the axis~~ of Y-direction indicates acceleration G, and the axis of X-direction indicates time t.

The reference numeral 802 designates the through-up waveform of the motor, and Y-direction represents speed and X-direction represents time t. In the waveform 802, the reference numeral 805 denotes an acceleration area, the reference numeral 806 designates an approach run area for eliminating the vibration caused during the through-up, and the reference numeral 807 denotes an image reading area for reading an image when the vibration during the through-up becomes null.

Here, the time t2 (803) from the starting of the motor until the vibration during the through-up is attenuated and image reading becomes possible can be made shorter by Δt (804) than the time t1 of the aforedescribed moving mechanism using only the magnet damper.

As described above, it is possible to reliably and efficiently reduce the natural vibration of the load system caused during the through-up of the motor by adding a rubber damper to the image reading drive system. Thereby, the approach run time for absorbing the vibration caused during the through-up can be reduced and therefore, the image reading time can be shortened and this contributes to the higher speed of ~~the apparatus. The approach run distance is also~~

Ins. a15 amd.

~~shortened and this contributes to the downsizing of the apparatus.~~

Thus, the present invention has paid attention to the fact that if as in the construction shown in Fig. 6, two damper means are mounted on the motor drive shaft, the vibration caused during the driving of the motor can be reduced, and has particularly derived the possibility of reducing the vibration caused during acceleration and during a constant speed by using a magnet damper as the first damper means and using a rubber damper as the second damper means, and utilizes this in the driving motor for the moving mechanism of an image reading apparatus to thereby shorten the reading time of the image reading apparatus and ~~heighten the speed of the apparatus.~~

Fig. 12 shows a simple equivalent view of a motor using two dampers, i.e., a magnet damper and a rubber damper.

Ins- a16

~~In Fig. 12, the reference numerals 701 and 702~~ designate springs, and the reference numeral 703 (corresponding to the reference numeral 301 in Fig. 3) denotes a motor, which provides a vibration source together with the springs 701 and 702. The reference numeral 704 designates a spring, the reference numeral 705 denotes a dash pot, and the reference numeral 706 designates inertia which is the equivalent constituent ~~of a rubber damper 707. The reference numeral 504~~

Ins. a16 cancel.

~~shows that an inertia member 505 (corresponding to what~~ is designated by the reference numeral 1101 in Fig. 11) by a magnet and a motor 503 which is a vibration source are connected together. Design is made such that the inertia member 505 does not react during acceleration because it is connected by the magnet, and when the motor is at a constant speed, the inertia member 505 is applied to the motor 503 which is a vibration source.

As described above, according to the present invention, during the through-up of the motor, it is possible to reliably and efficiently reduce the natural vibration of the load system by the rubber damper, and during the constant speed of the motor, it is possible to smooth the rotation between step angles by the magnet damper, and it is possible to reduce the ~~vibration.~~